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DRYING-RATE NOMOGRAPHS. VIII. CARROT PIECES

Western Regional Research Laboratory, Albany, California
Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
U. S. Department of Agriculture

A method of estimating drying times from drying-rate nomographs has been published in the form of a processed circular (AIC-31-I), and drying-rate nomographs are available for riced white potatoes (AIC-31-I), blanched sweet corn (AIC-31-II) white potato strips under through-flow conditions (AIC-31-III), shredded cabbage (AIC-31-IV), onion slices (AIC-31-V), sweetpotato strips (AIC-31-VI), and white potato half cubes (AIC-31-VII).

The drying-rate characteristics of 1/4" x 3/8" x 3/8" pieces of carrot (Chantenay variety) are presented nomographically in this circular. The carrots were peeled by abrasion, trimmed by hand, washed, and cut into pieces in a mechanical cutter. The carrot pieces were blanched for 4 minutes in steam at atmospheric pressure and at a loading density of 4 lbs./sq.ft. After an air cooling period of 5 minutes, the blanched material was loaded on the drying trays.

The nomographs presented in this circular deal with the drying rates of carrot pieces on both metal grid and wooden slat trays under cross air flow conditions. The diagrams included are:

Metal Grid Trays	Wooden Slat Trays	Subject
Figure 1	Figure 3	Drying times from $T_o = 8.4$ to $T = 0.2$ at reference conditions of L_o and V.
" 2	" 4	θ corrections for $T_o > 8.4$.
Metal Grid or Wooden Slat Trays		
Figure 5		Effect of L_o and V on Figures 1 and 3.
" 6		Drying times from $T = 0.2$ to T_f.

The effects of air velocity and tray loading density upon drying times from T_o to $T = 0.2$ are related by the equation

$$\theta \text{ (at } V, L_o) = \theta_r \cdot f(V, L_o).$$

In this equation, θ_r is the drying time from T_o to T under reference conditions (V = 780 ft./min. and L_o = 1.5 lbs./sq.ft.) as obtained from Figure 1 or Figure 3, and values of $f(V, L_o)$ are obtained from Figure 5. The function $f(V, L_o)$ must correspond to the values of V and L_o under consideration, and must be selected at the value of T to which θ and θ_r apply. (The nomenclature used is that listed in processed Circular AIC-31-I.)

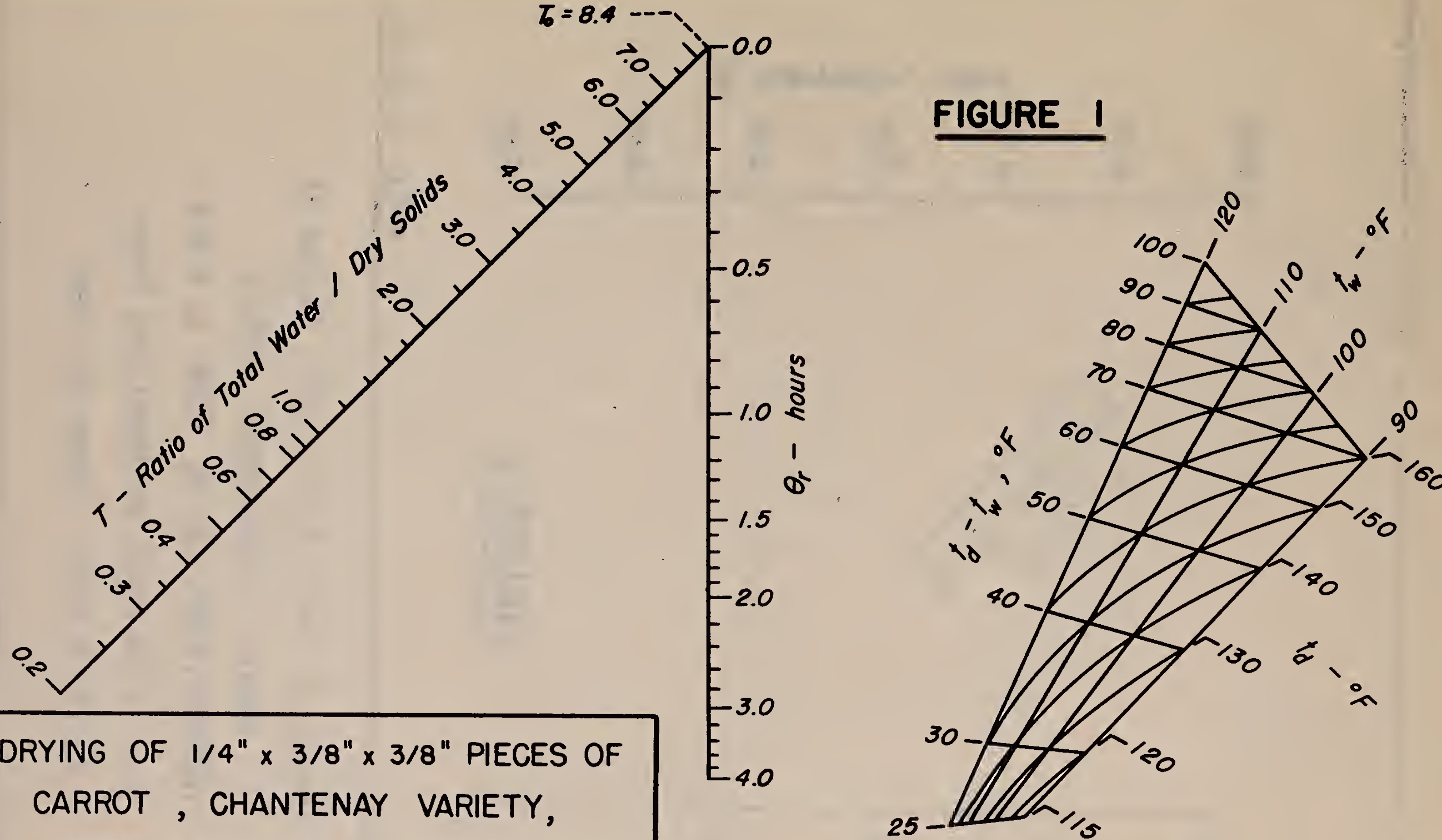
Below $T = 0.2$, drying times under cross air flow conditions are essentially independent of air velocities ranging from 400 to 1,100 ft./min. and of tray loading densities ranging from 0.75 to 2.5 lbs./sq.ft. at T_o. The data of Figure 6,

therefore, are considered suitable for estimating drying times in finishing bin (through-flow of air) types of driers within limits of ±0.5 hrs. at T = 0.08, and ±1.5 hrs. at T = 0.05. The limited accuracy arises in part from effects of previous drying history. During the final drying stages, and under identical final drying conditions, carrot pieces which have been dried rapidly in the high moisture range continue to dry rapidly in the low moisture range, and carrot pieces which have been dried slowly in the high moisture range continue to dry slowly in the low moisture range. The phenomenon is apparently related to the piece density at the beginning of drying in the low moisture range.

Moisture contents as used in the nomographs presented in this circular were determined as follows: The material on the tray was equalized in a sealed container for at least 24 hours, ground in a Wiley mill to pass a 2-mm. screen, and the resulting powder thoroughly mixed. Portions of the ground material were dried for 16 hours at 70° C. and an absolute pressure of 8 to 10 mm. of mercury. The loss in weight was taken as representing moisture loss. The method gives somewhat higher results than the 6-hour method which has commonly ~~been~~ used in inspection of dehydrated vegetables for Government purchase. The difference between results by the two methods is somewhat variable, the 16-hour method (on the average) indicating a moisture content about 1 percent higher than the 6-hour method in the moisture range of 6 to 7 percent.

Although the nomographs presented in this circular pertain to 1/4" x 3/8" x 3/8" pieces of Chantenay carrot, they may be used for approximating drying times for 3/16" x 3/8" x 3/8" pieces of Imperator carrot. The latter dry in approximately 85 percent of the time required for the former. Drying times so estimated for Imperator carrots should not be in error by more than 15 to 20 percent.

FIGURE I



DRYING OF 1/4" x 3/8" x 3/8" PIECES OF CARROT , CHANTENAY VARIETY, FROM T = 8.4 TO T = 0.2

L_o = 1.5 lbs./sq.ft. on Metal Grid Trays

V = 780 ft./min. , Cross Air Flow

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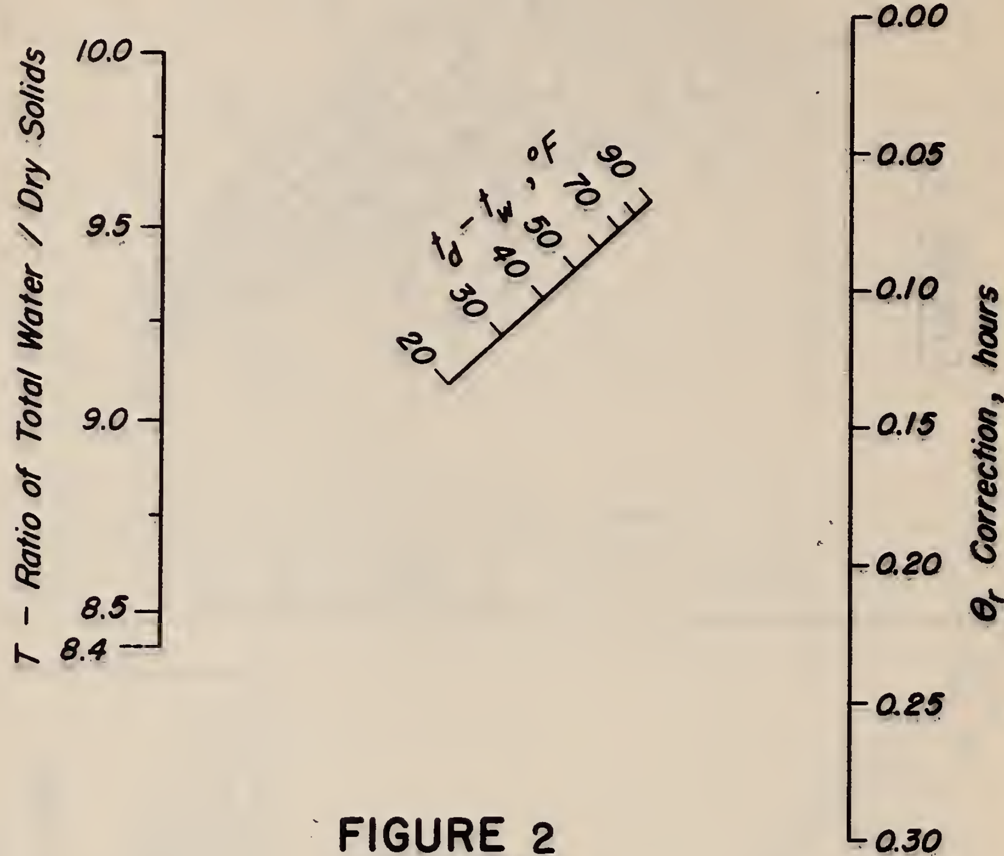

FIGURE 2

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Drying of 1/4" x 3/8" x 3/8" Pieces of
Carrot , Chantenay Variety
CORRECTION OF θ_r FOR $T_o > 8.4$
L_o = 1.5 lbs./sq.ft. on Metal Grid Trays
V = 780 ft./min. , Cross Air Flow

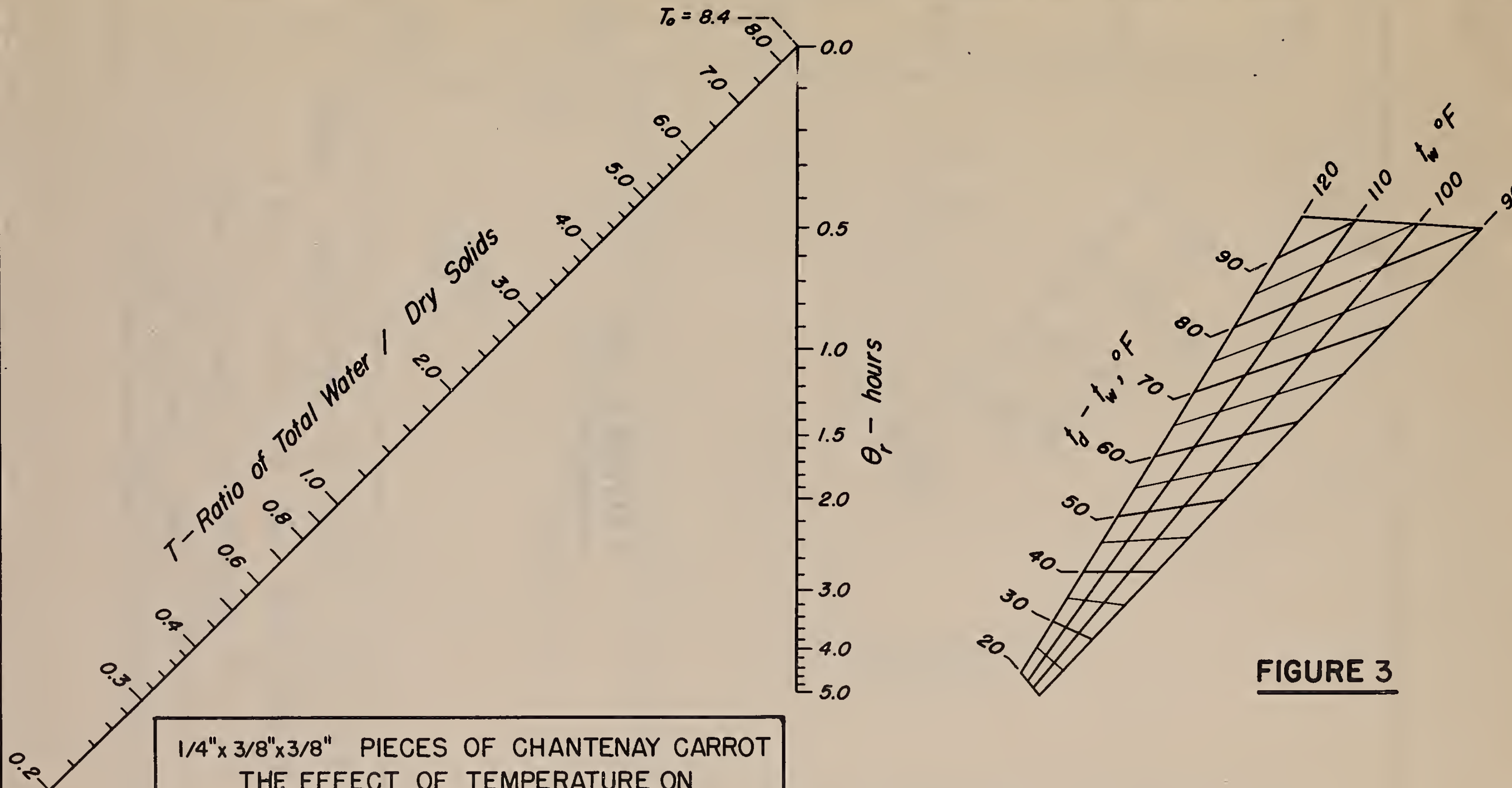

FIGURE 3

1/4" x 3/8" x 3/8" PIECES OF CHANTENAY CARROT
THE EFFECT OF TEMPERATURE ON
THE DRYING FROM T_o TO T = 0.2
L_o = 1.5 lbs./sq.ft. on wooden slat trays
V = 780 ft./min., cross air flow

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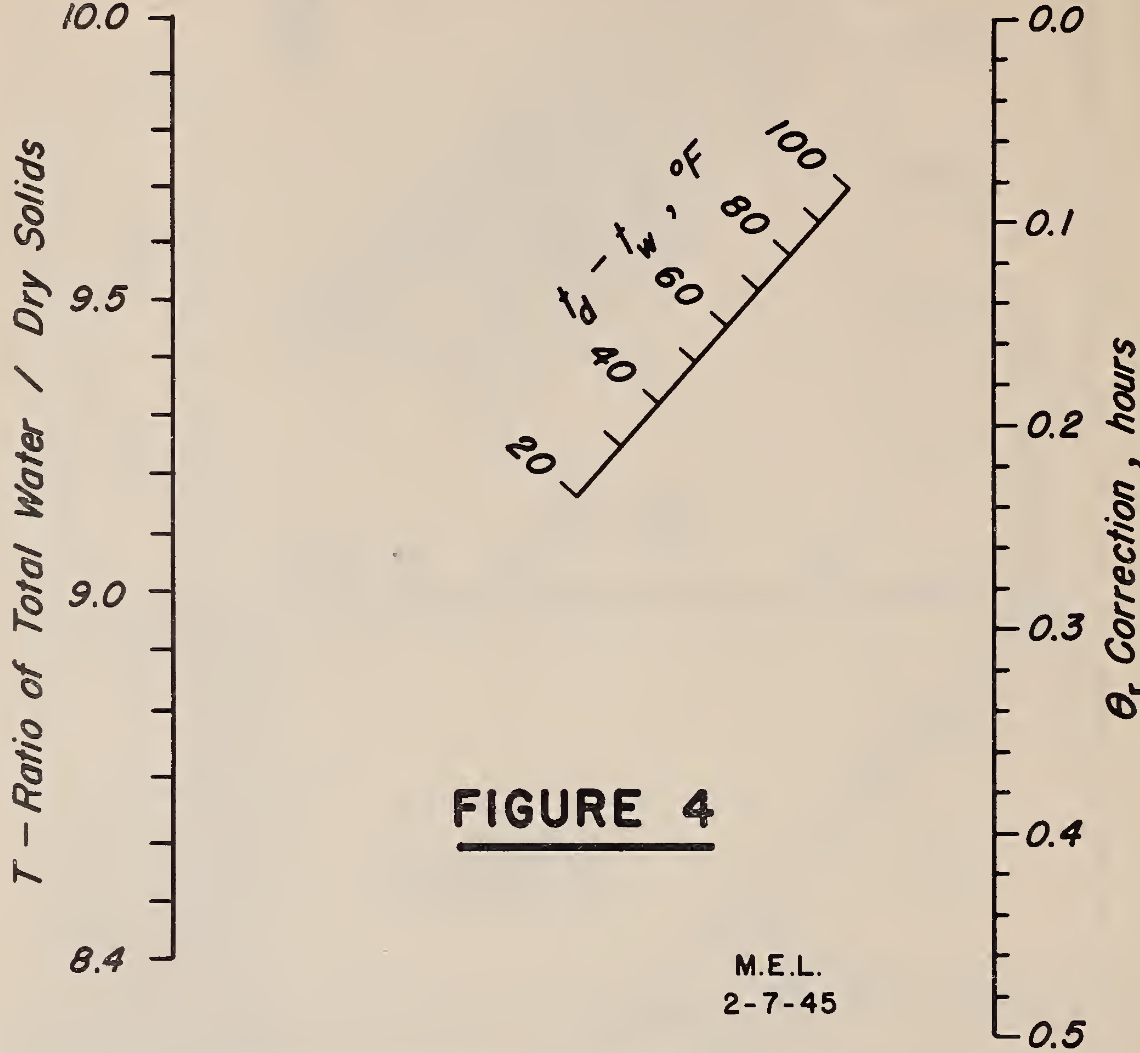

FIGURE 4

1/4" x 3/8" x 3/8" PIECES OF CHANTENAY CARROT

CORRECTION OF θ_r FOR $T_o > 8.4$

L_o = 1.5 lbs./sq.ft. on wooden slat trays

V = 780 ft./min., cross air flow

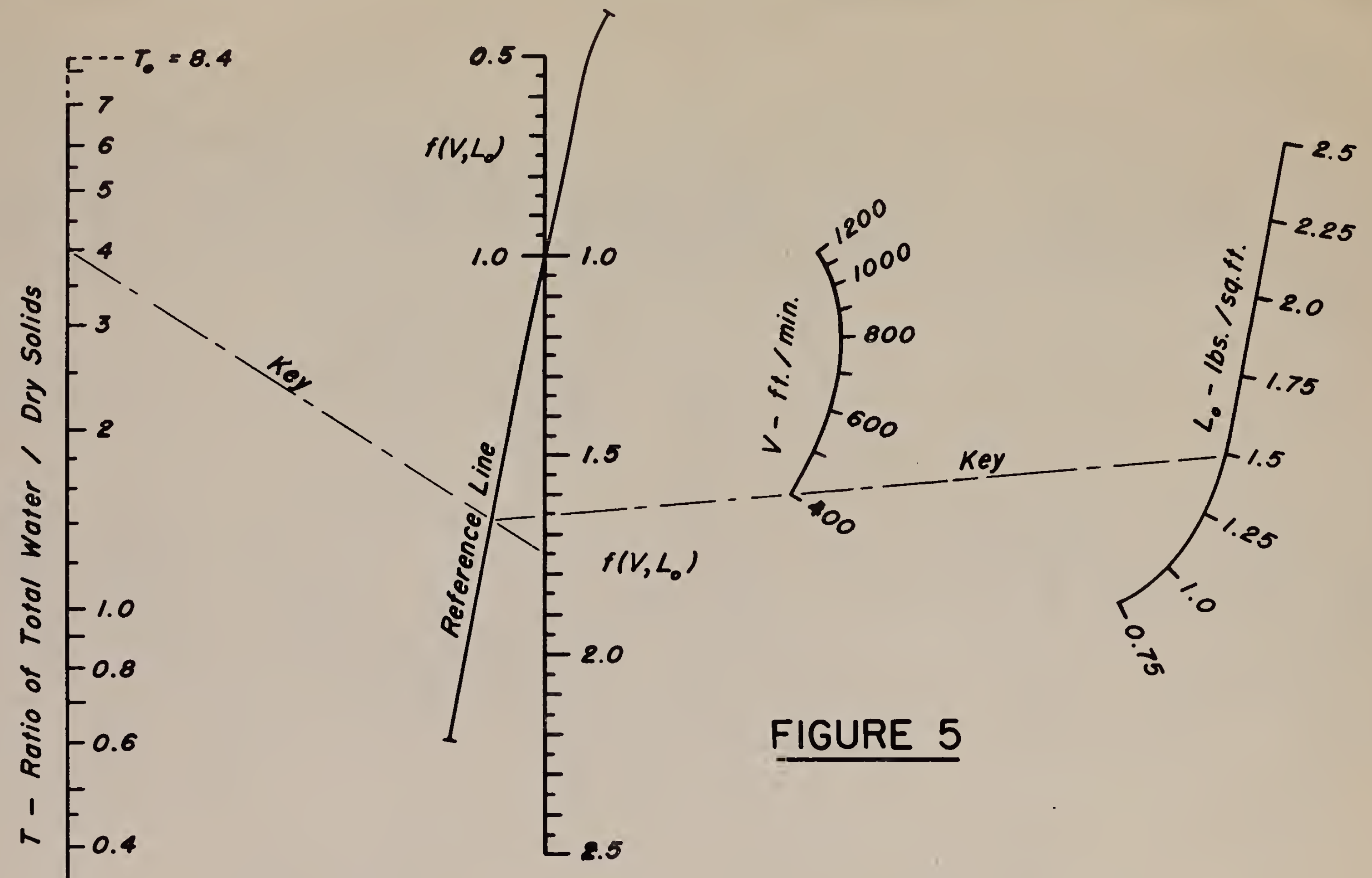

FIGURE 5

Key
Connect L_o – V – Ref. Line
Connect T – Ref. Line – $f(V, L_o)$

1/4" x 3/8" x 3/8" PIECES OF CHANTENAY CARROT
$f(V, L_o)$ for the drying from T_o to $T = 0.2$
Metal Grid or Wooden Slat Trays

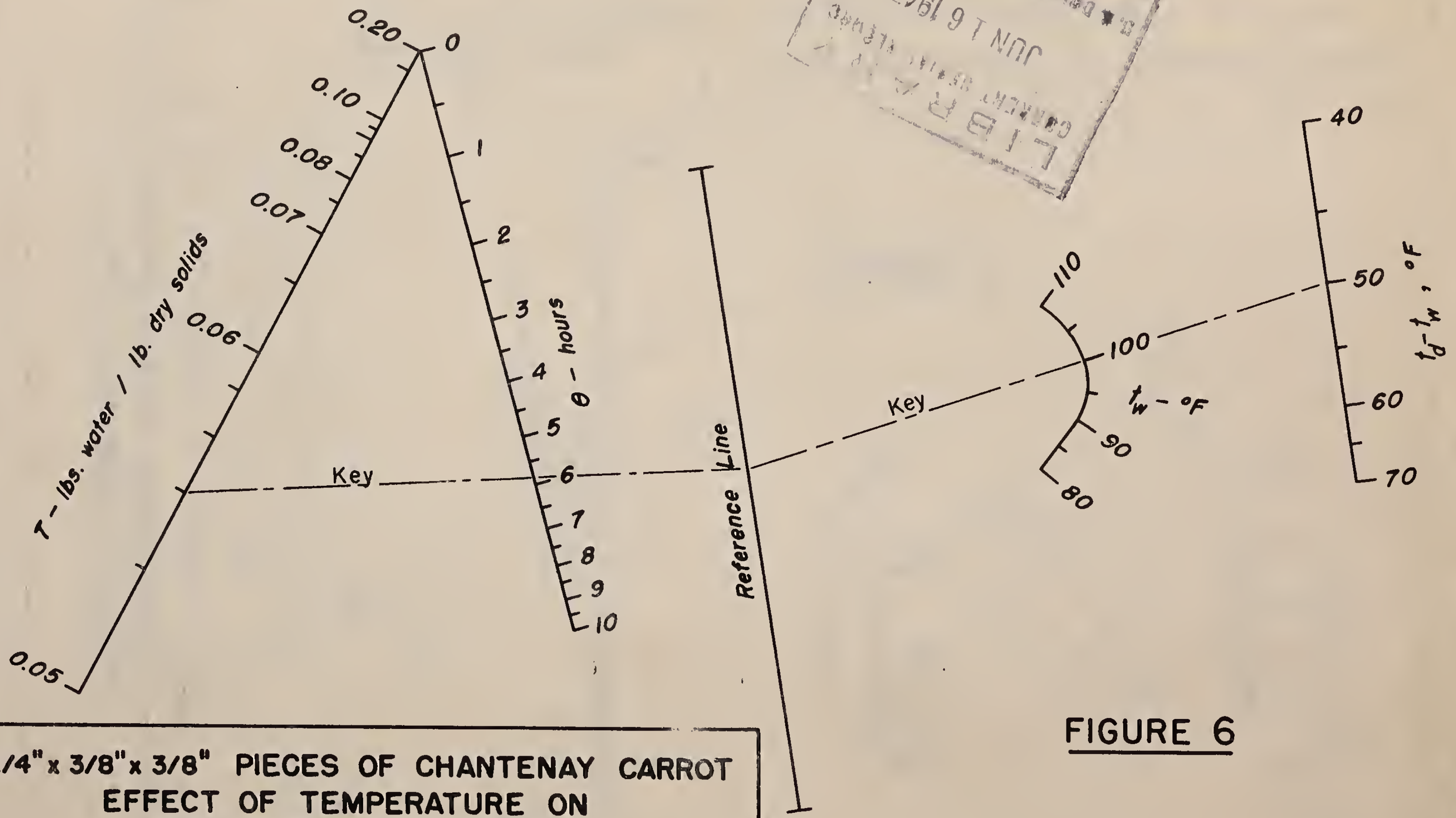

FIGURE 6

1/4" x 3/8" x 3/8" PIECES OF CHANTENAY CARROT
EFFECT OF TEMPERATURE ON
DRYING FROM T = 0.2 TO T_f

L_o = 0.5 – 3.0 lbs./sq.ft. on metal or wooden trays
V = 400 – 1400 ft./min., cross air flow